the STEEL centre

challenge traditional boundaries.

2018 ANNUAL REPORT

Dr. Robert Driver
Director

UNIVERSITY OF ALBERTA

cisc icca

CISC Centre for Steel Structures Education and Research
University of Alberta
Faculty of Engineering
Department of Civil and Environmental Engineering

cool stuff for the real world.

contents

from the director

This has been an inspiring year at the Steel Centre: we launched our brand identity, added to our faculty and student numbers, gained new support in the form of three additional industry sponsors, launched a student-led consultancy, and sent representatives to Bolivia to oversee bridge construction for a rural, isolated community. Students have been hard at work, with two M.Sc. defenses in early 2018 and 25 peer-reviewed papers published since the inception of the Centre.

While the numbers certainly demonstrate a strong and growing centre, the data that is harder to capture numerically is also some of the most intriguing. Students feel more connected than ever before to structural engineering, to the faculty, and to the industry at large as we form new partnerships and opportunities for meaningful mentorship. The Steel Squad, our flagship undergraduate program, has instilled real appreciation for the work that practicing engineers do, and is preparing students for the workplace in ways never before attempted. These connections with real-world engineering have captured the imagination of graduate students as well; based on student input, the Steel Centre made available several events for graduate student participation and there is a robust following from both the Master's and Ph.D. level. With this year's launch of the Steel Centre Certified certificate, we have a new way to target specific active learning and experience-based objectives and present that additional knowledge in a format that is understandable to industry and other institutions.

I am grateful for the continual support from our industry partners, the Faculty of Engineering, and the University of Alberta community. The Steel Centre's slogan is "challenge traditional boundaries" and I believe this year marks the start of an ongoing process to move engineering education and research beyond their traditional boundaries into a new, challenging, and innovative space.

Robert G. Driver
Director

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the STEEL centre

vision

The Steel Centre **imagines and transforms** the future of structural steel design, fabrication, and construction.

mission

We are an i**ndustry-driven, student-centred** education and research network dedicated to **continually advancing the steel industry**, engaging in interdisciplinary collaborative research, providing **innovative education opportunities**, and developing leaders of the future.

values

We **challenge traditional boundaries.**

We are a **collaborative community** with uncompromised integrity.

Excellence is in our DNA.

We do **cool stuff for the real world!**

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people

Dr. Robert Driver, P. Eng.
Supreme Steel Professor
Steel Centre Director
Steel Structures

Dr. Ali Imanpour, P. Eng.
Assistant Professor
Steel Structures

Dr. Roger Cheng, P. Eng.
Professor, C.W. Carry Chair of Steel Structures
Steel Structures

Dr. Leijun Li, P. Eng.
Professor
Welding Metallurgy

Dr. Doug Tomlinson
Assistant Professor
Steel/Concrete Composite Systems

Dr. Yong Li
Assistant Professor
Reliability & Advanced Analysis

Dr. Yasaman Balazadeh Minouei
Post-doctoral Fellow
Steel Structures

Dr. Bo Dowswell, P. Eng.
Consulting Research Engineer
Steel Structures

Matt Jeppesen
Programs Administrator

Greg Miller
Structural Engineering Technician

Cam West
Structural Engineering Technician

current students

Safa Masajedian (Ph.D.)
Supervisors: Dr. Driver, Dr, Imanpour
Progressive Collapse Resistance of Composite Steel Frame Structures

Dimple Ji (M.Sc.)
Supervisors: Dr. Driver, Dr. Imanpour
Lateral-torsional Buckling Tests of Welded Wide-Flange Girders

Michael Manarin (M.Sc.)
Supervisor: Dr. Driver, Dr. Yong Li
Lateral-Torsional Buckling of Singly Symmetric Welded Three Plate Girders

James Koch (B.Sc.)
Supervisor: Dr. Driver
Asymmetry Factor of Singly-Symmetric Beams in Lateral Torsional Buckling

Daniel Unsworth (M.Sc.)
Supervisors: Dr. Driver, Dr. Leijun Li
Residual Stresses in Welded Girders

Ahmed Mowafy (Ph.D.)
Supervisors: Dr. Imanpour, Dr. Chui
Advanced Hybrid Steel–Timber System for Seismic Applications

Abolfazl Ashrafi (Ph.D.)
Supervisor: Dr. Imanpour
Seismic Response Evaluation and Design of Steel Multi-tiered Eccentrically Braced Frames

Eshagh (Isaac) Derakhshan Houreh (M.Sc.)
Supervisor: Dr. Imanpour
Development of Simplified Seismic Design Guidelines for Steel Concentrically Braced Frames in Regions of Low and Moderate Seismicity

Pablo Cano (M.Sc.)
Supervisor: Dr. Imanpour
Evaluation of Seismic Design Methods for Steel Multi-Tiered Concentrically Braced Frames

Akram Zain (M.Sc.)
Supervisors: Dr. Imanpour, Dr. Driver
Performance and Design of Prefabricated Steel Braced Frames for Industrial Buildings

Daniel Brockerville (B.Sc.)
Supervisor: Dr. Imanpour
Evaluation of Pre-Fabricated Structural Systems in Canada

Ian Chin (M.Sc.)
Supervisors: Dr. Driver, Dr. Tomlinson
Standardization of Embedded Plates for Steel/ Reinforced Concrete Connections

Brittney Lopushinsky (M.Sc.)
Supervisors: Dr. Tomlinson, Dr. Driver
Rehabilitation of Deficient Concrete Columns with Steel Confinement Collars

Adam Coleman (M.Eng.)
Supervisor: Dr. Driver
Stability of Extended Shear Tabs

the STEEL centre

2018 highlights

eight researchers supervising **fourteen research students**

ten members from across Canada with operations throughout North America

- CISC ICCA
- Supreme Group
- Waiward
- Collins Steel
- WF Steel & Crane
- DIALOG
- S-FRAME Software
- Price Steel Ltd.
- TSE Steel Ltd.
- ECA Edmonton Construction Association

three new members in 2018

four active CRDs

$135,000 annual industry funding committed for **five years**

CISC ICCA | University of Alberta

who are we?

The Steel Centre goes beyond the traditional boundaries of academic research

No organization quite like the Steel Centre exists in Canada. It is unique in its focus on rethinking the education of young engineers, developing unconventional modes of instruction, and conducting leading-edge research in steel construction by leveraging synergies via a nurtured network involving both university and industry expertise. The Steel Centre strives to anticipate and shape future educational and industry thinking by increasing and optimizing the nature of interactions for the benefit of both students and industry. We also envision unique partnerships outside the traditional bounds of structural engineering, e.g., with Computer Science, to investigate the overlapping territory of these fields as they relate to steel construction.

Dr. Robert Driver, an established and highly recognized professor, has been appointed as the inaugural Director of the Steel Centre. With a solid combination of industry experience and high-quality academic research, Dr. Driver brings a balanced and thorough vision to the Steel Centre's overall operations. Most recent in his many awards and recognitions is being named a Killam Professor, recognizing career excellence in advancing Canada's higher education. Dr. Driver reinforces the University of Alberta's role as a prominent leader in the steel construction industry at an international scale.

Dr. Ali Imanpour, the first full-time faculty member hired specifically for the Steel Centre, has demonstrated enormous potential in the early stages of his career, winning the 2017 CISC H.A. Krentz award for the top-ranked steel research proposal in Canada for his work on design guidelines for steel structures in seismic areas. His research in structural stability and simulation adds a strong base for the Steel Centre's initiatives.

To date, three other professors co-supervise work under the Steel Centre: Dr. Doug Tomlinson (Civil and Environmental Engineering), Dr. Leijun Li (Chemical and Materials Engineering), and Dr. Yong Li (Civil and Environmental Engineering).

The Steel Centre goes beyond the traditional boundaries of other research endeavours, with an expressed goal of expanded focus on, and generation of, industry-shifting best practices for both engineering education and industry–academic collaboration. The Steel Centre consolidates and makes visible the University of Alberta's substantial expertise in steel design and construction by providing a central and consistent brand. A named partnership with the Canadian Institute of Steel Construction, the nation's largest and most-recognised steel industry association, strengthens this brand considerably in both industry and government.

The current membership of the Steel Centre consists of ten companies and organizations from across Canada, with new members joining each year. The five-year membership model provides the financial stability of an IRC, but allows more flexibility to incorporate new members and continue the relationship indefinitely. It is also structured in a way that facilitates reacting quickly to capitalise on unique opportunities as they arise.

The Faculty of Engineering currently seeks to cultivate meaningful relationships with external industry partners, both to advance the high-quality research for which the Faculty is known, and to open up philanthropic opportunities for distinguished alumni. The Steel Centre adds value to this process by developing and deepening ongoing relationships and building a greater sense of engagement, purpose, and trust within the industry–academic dynamic. The Steel Centre transforms traditional arm's-length

industry research support from a one-time financial transaction to an ongoing conversation involving organizational leadership, students, researchers, and relevant industry partners. Industry members have been the first to recruit new members, demonstrating the perceived value of the Steel Centre outside of the University.

The University of Alberta benefits from a deeper, more engaged partnership with external industry partners; resilient, stable funding for ongoing research in multiple streams; a consolidated image of the University's work in steel design and construction, which is currently fragmented amongst various researchers and departments; national media coverage through a named partnership with CISC; improved student training and post-university outcomes for students; and improved ability to attract and retain top talent.

Students benefit from new co-curricular training and opportunities that are in demand in the workplace. These programs stay relevant through intentional industry advice and feedback. University of Alberta graduates will become known as better-prepared and more job-ready. Through their work with and alongside practicing professionals, students develop strong connections to key industry figures, resulting in increased potential for timely and gainful employment upon graduating, with skill sets and topics of study that are transferrable and applicable to current industry needs.

vision

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strategic planning

The Steel Centre dedicates time to crafting an intentional plan for growth.

In 2017, a formal strategic planning process was undertaken for the Steel Centre that included University of Alberta personnel, industry stakeholders, and guests with an interest in this initiative and who are influential in the construction industry. The process was anchored in two full-day workshops: the first staged as a visioning exercise,

wherein big ideas were explored and areas of alignment and misalignment of the participants were identified and debated; and the second for strategic planning in order to set a clear path toward achieving these goals. Among the outcomes of these sessions were the carefully crafted vision, mission, and values of the Steel Centre (at left).

Several recurring themes were identified throughout the strategic planning process. Participants voiced a need for consistently demonstrating value to industry in order to ensure financial sustainability, generate innovative research projects, and attract new collaborators. One aspect of that value is that the Steel Centre must challenge traditional boundaries, both in terms of diversity of collaborations and considering unconventional educational experiences. We will seize opportunities that add value, without limiting ourselves to our safe spaces.

The Steel Centre Strategic Plan provides high-level guidance for the Centre, and as such intentionally does not address details of implementation. Detailed "objectives" squarely in alignment with the strategic directions have been further developed and work is in progress to achieve these goals. With these clear strategic directions in place, the Steel Centre team can develop new programs and implement the necessary work plans.

Central to the Steel Centre's existence is the interplay between academia and industry. We are industry-driven, but student-centred. The aspiration of the Steel Centre is to train the world's best structural engineers, leveraging the fact that our academic programs are fully informed by and integrated with the industry in which our young professionals will work. Steel Centre members are engaged directly with our education programs so that graduates are truly industry-ready, and Centre members can confidently hire new talent.

With this substantial groundwork laid, we are excited to join our industry partners in transforming the steel construction industry by producing valuable, innovative, and "cool" research–and by shaping our students into the best engineering graduates in the field!

research

At the Steel Centre, every student, including undergraduates, is involved in a research project. This hands-on experience coupled with outstanding education quality produces students that have a deeper, more natural understanding of steel construction. Steel Centre students work closely with partners from Alberta's leading companies to identify and solve real problems faced by the steel construction industry.

Steel structures research at the University of Alberta typically involves both large-scale testing in the I.F. Morrison Structural Engineering Laboratory, as well as computer modelling including high-fidelity applications. Steel structures research carried out at the University of Alberta has been influential in the development of design codes and standards world-wide.

Current research at the Steel Centre covers a range of topics, but one theme is especially prominent. One significant area of work is investigating lateral-torsional buckling (LTB) and concerns that the current design equations for welded steel girders may be unconservative. Students in the LTB group are measuring the effects of residual stress on LTB capacity and this year will conduct the country's largest full-scale bridge girder test, providing up-to-date data that takes into account the significant changes in modern fabrication techniques since the seminal LTB work done in the 1970s.

See the list at right for other significant areas of research at the Steel Centre.

recent research topics

lateral-torsional buckling

Lateral-Torsional Buckling in Wide-Flange Welded Girders

Residual Stresses in Welded Girders

Lateral-Torsional Buckling of Singly Symmetric Welded Three Plate Girders

Asymmetry Factor of Singly-Symmetric Beams in Lateral Torsional Buckling

progressive collapse

Progressive Collapse Resistance of Composite Steel Frame Structures

One-sided Steel Shear Connections in Column Removal Scenario

Behaviour of Steel Shear Connections for Assessing Structural Vulnerability to Disproportionate Collapse

seismic design guidelines

Steel Plate Shear Walls for Low and Moderate Seismic Regions and Industrial Plants

Development of Simplified Seismic Design Guidelines for Steel Concentrically Braced Frames in Regions of Low and Moderate Seismicity

Evaluation of Seismic Design Methods for Steel Multi-Tiered Concentrically Braced Frames

Seismic Performance of Prefabricated Steel Braced Frames Industrial Buildings

other

Evaluation of Pre-Fabricated Structural Systems in Canada

Design and Behaviour of Extended Shear Tabs Under Combined Loads

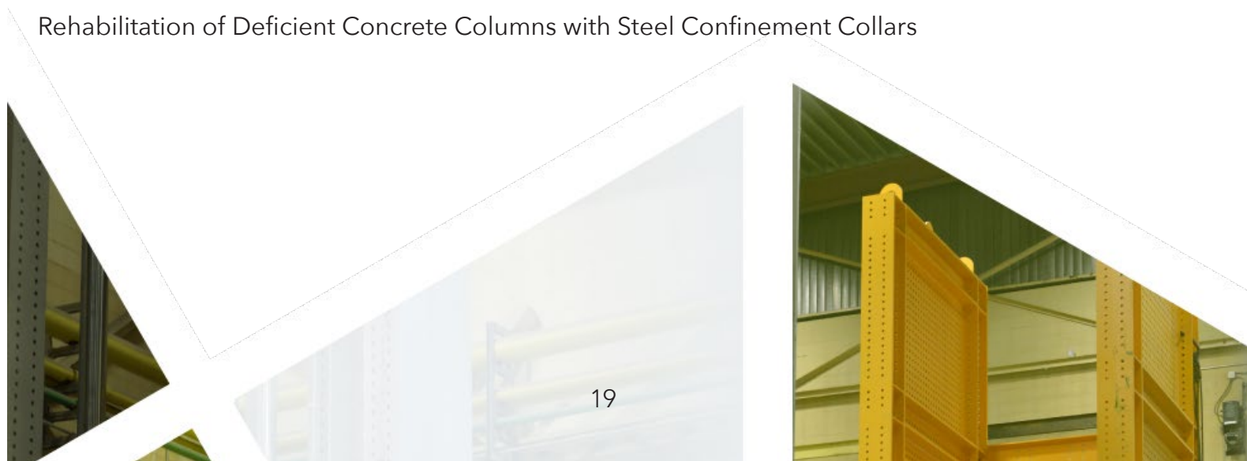
Stability of Extended Shear Tab Connections

Strength and Behaviour of Double-coped Steel Beams Under Combined Loads

Complex Load Sharing In Weak-Axis Moment Connections

Standardization of Embedded Plates for Steel/Reinforced Concrete Connections

Rehabilitation of Deficient Concrete Columns with Steel Confinement Collars



lateral-torsional buckling

Dimple Ji (M.Sc.)
Daniel Unsworth (M.Sc.)
Michael Manarin (M.Sc.)

Dr. Robert Driver
Dr. Ali Imanpour
Dr. Leijun Li
Dr. Yong Li

Supreme Steel
SSAB Americas

Concerns exist that current Canadian design standards overestimate the strength of welded girders (commonly used in bridges), bringing the safety of the standard into question. Though there is evidence to support the concerns, there is insufficient research on the subject to warrant a change in the standard; further work needs to be done to make an informed decision.

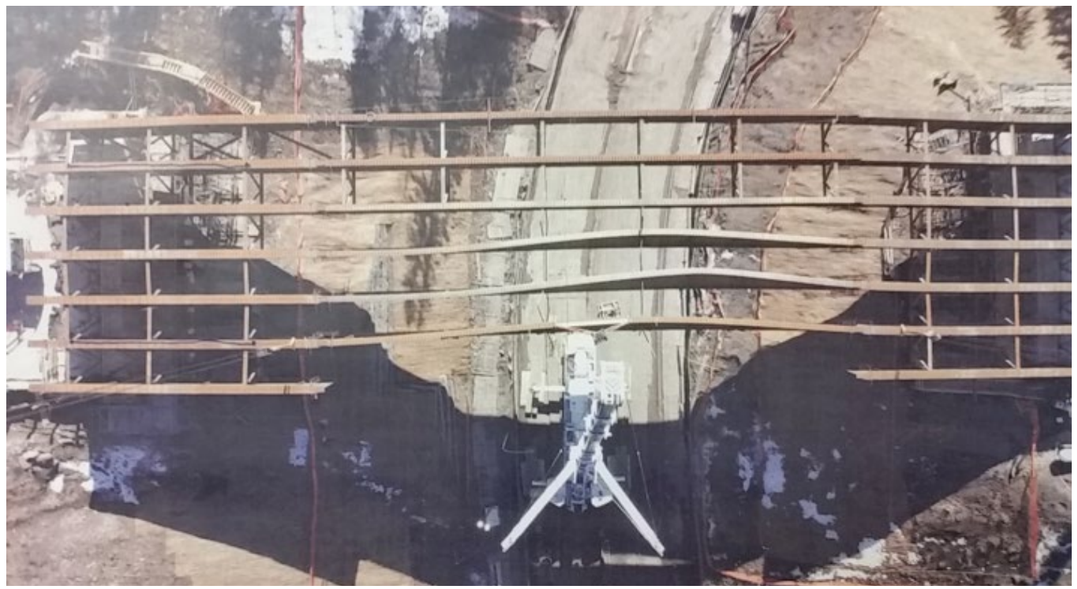
If current standards are in fact unsafe, the resulting changes in girder designs will see costs increase significantly for steel fabrication. This will be in addition to the time and money expended in assessing the safety of pre-existing bridges to ensure their continued safe operation.

Daniel Unsworth

Daniel Unsworth's work assesses the effect of welding on the internal (residual) stresses of girders through advanced stress measurement techniques. This data will be used to gain a better understanding of how modern fabrication procedures affect the behaviour of welded Canadian bridge girders. Having more detailed internal stress data on these girders will provide a more complete understanding of girder failure mechanisms. This will not only enable proper assessment of the design standard, but will pave the way for future research on girder behaviour.

Dimple Ji's research aims to improve understanding of lateral-torsional buckling in welded girders. The lateral-torsional buckling design provisions were developed decades ago, and since then welding and fabrication processes have changed significantly. The complexity of performing lateral-torsional buckling tests has also resulted in a severe lack of recent experimental test data. The research involves conducting a series of large-scale physical tests on modern welded sections. The results of the test will be used to evaluate and improve, if necessary, the existing lateral-torsional buckling provisions for welded girders. The result is a more rigorous standard for practicing engineers, which creates greater confidence in design.

Dimple Ji



Steel Centre Sleuths Set Out to "Crack" Puzzling Hot-dip Case

Chris DiGiovanni, M.Sc. Waiward Steel
Dr. Leijun Li Daam Galvanizing
Dr. Robert Driver

Hot-dip galvanizing is a common procedure used to protect structural steels from corrosive environments. However, in a recent construction project involving welded steel platforms, numerous joints were found with large cracks in the welded areas after galvanizing, while in similar projects cracking did not occur making this an unforeseen and new phenomenon. This led to a Steel Centre research project being carried out by M.Sc. student Chris DiGiovanni (above), co-supervised by Profs. Leijun Li and Robert Driver.

Given the nature of the hot-dip procedure, liquid metal embrittlement is an obvious consideration in determining the source of the platform cracking. However, literature suggests that there may be numerous factors at play, such as hydrogen embrittlement. Furthermore, hydrogen cracking susceptibility depends on residual stresses, hardness, and hydrogen content. Given that there is no history of cracking during galvanizing in previous similar projects, the stress field present before and induced during galvanizing and the base material microstructure are also key parameters to consider.

This research project is determining the cause of the cracking in the welded joints, and specifically why it occurred in this structure but not others, by exploring the mechanical properties of the base material, the residual stresses induced by the hot-dip galvanizing process, and the fracture surfaces of the cracks. It is expected that the parent material microstructure, along with the fabrication sequence, played a role in the sensitivity of the structure to cracking. This project is another example of how the Steel Centre is partnering with the steel construction industry to address pressing needs and helping to improve design efficiency and construction processes.

Chris DiGiovanni with a test specimen in the IF Morrison Structural Engineering Laboratory

stability of extended shear tab connections

Victoria Buffam, M.Sc. 2018

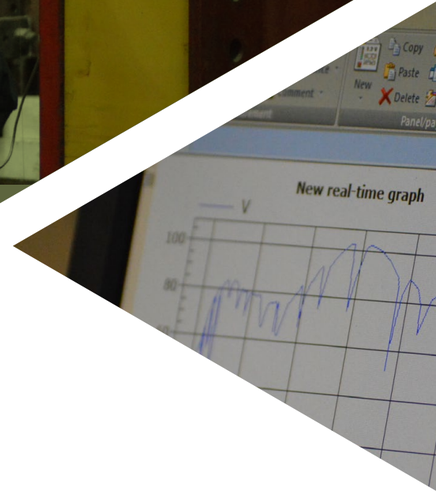
Dr. Robert Driver

Waiward Steel LP

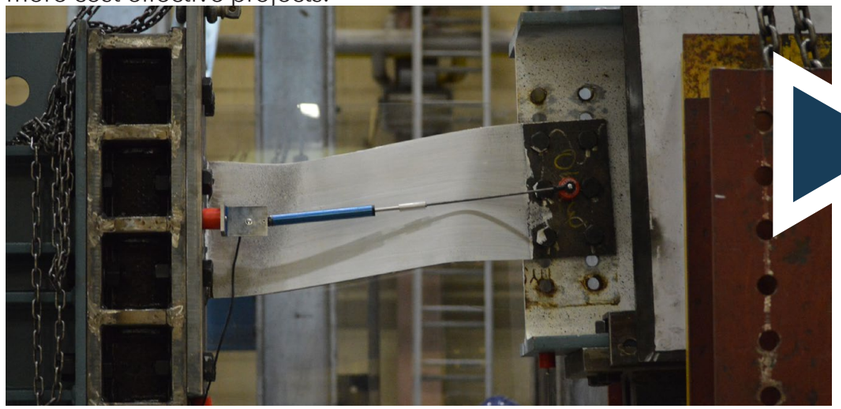
The behaviour of extended shear tabs differs from those with a conventional configuration, as the increased length of the plate introduces potential stability concerns. Since these connections are very common and frequently used, their design efficiency can really impact the cost and construction time of a project.

Because this behaviour is not well understood, designers have typically adopted a conservative approach where the plate thickness is increased or stiffeners are added to prevent plate buckling, eliminating the economic advantage of the connection.

A numerical and physical parametric study has been conducted to determine when instability becomes the governing failure mode, as opposed to cross-sectional strength. The study investigated the effect of varying plate thickness, depth, length and level of axial load with a stiff boundary condition. Ultimately, this research developed readily-implemented design procedures that address lateral stability for extended shear tab connections.



A better understanding of the behaviour of extended shear tab connections will lead to design procedures which are easier to implement and result in safer, more cost effective projects.



An extended shear tab deforms during physical testing. June 2017.

education

Education is the core of the Steel Centre mission. Reaching beyond the traditional research group, the Steel Centre seeks to become the hub for innovative engineering education. The University of Alberta has a well-established reputation for the high quality of its engineering graduates. With the Steel Centre, that academic excellence is complemented by new, more immersive and hands-on experiences in the same settings that graduates will one day practice as professionals.

Steel Centre member organizations take a highly integrated role in the training of our young engineers. They provide feedback on ongoing research, share insights into technology trends in industry, and teach students the skills they'll need to succeed from day one.

Steel Centre students come from all levels of their academic career, from new undergrads to Ph.D. candidates. Everyone benefits from our close relationships with industry and up-to-date understandings of the changing professional landscape. This year, we launch our most anticipated program: Steel Centre OutReach Engineering (SCORE), a student-led engineering consultancy that takes on real projects with Steel Centre member organizations. We are excited to see these innovations take shape in the coming year.

hands-on education for undergrads

The Steel Squad began in Fall 2017 as a competitive-entry group to provide unique opportunities for undergraduate students interested in structural steel. Five students from any program year are selected annually, and remain in the Squad for the duration of their academic careers. The Squad welcomed its first five members in 2017 and will grow to the full complement of approximately 15 members by Fall 2019. The Steel Squad offers students real-world experiences such as shop tours, jobsite tours, job shadowing and mentorship, and hands-on demos such as an exciting welding day hosted in November by Collins Steel Ltd. Enthusiasm is extremely high from both industry and students to explore how to further expand the reach and impact of this new program. In 2018, the Steel Centre piloted a certification program for the Squad to document and recognize the range of experiences that the program offers.

Education is the core of the Steel Centre mission, and we will continue to work with industry partners, academic institutions, and students to craft new opportunities to dramatically improve the educational experience of engineering students at the University of Alberta.

brown paper thinking

a group effort to rethink our processes leads to a new co-curricular program

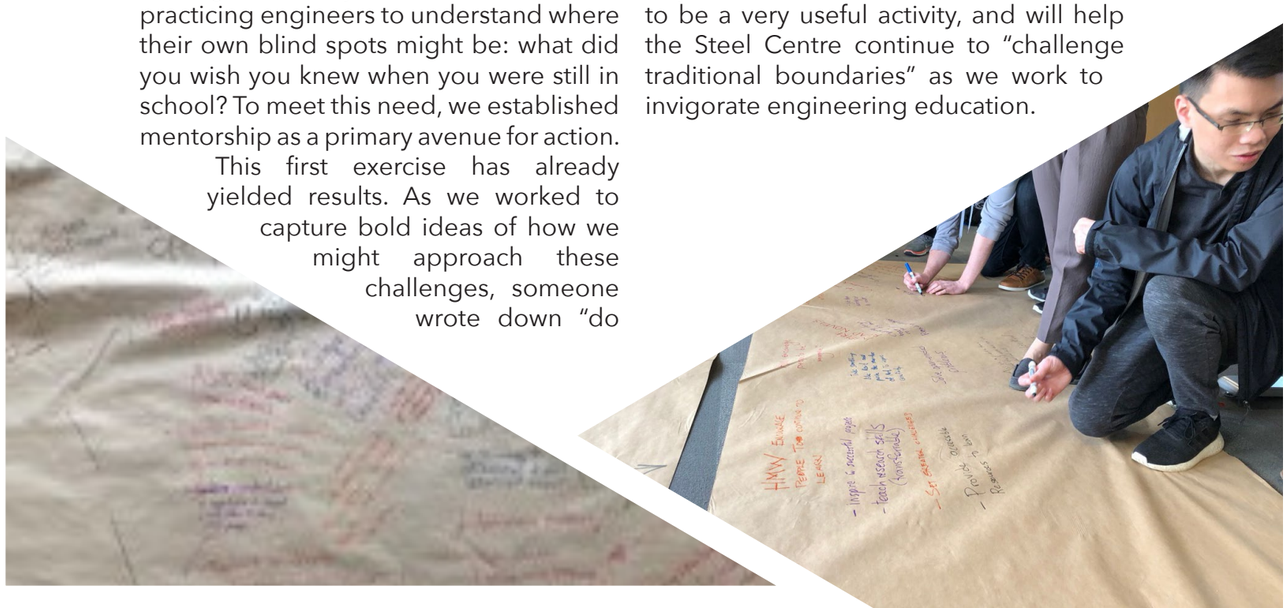
Students and professors from the Steel Centre spent a morning in a creative exploratory-thinking exercise called "Brown Paper". Through a guided process of examining student and faculty perceptions of which aspects of education are currently most and least effective, we uncovered many insights into areas of strength and opportunity for engineering education, which will shape Steel Centre programming for the coming year. While the University of Alberta's engineering program is one of the best in the country, there is still a set of skills and concepts that are missing when students arrive to their first day on the job. The Steel Centre is working with our industry partners to identify those skills and close the gap.

Students identified the program's strong technical skills and good employment prospects, but expressed concern about 'really knowing' how to be an engineer. They wanted to hear from practicing engineers to understand where their own blind spots might be: what did you wish you knew when you were still in school? To meet this need, we established mentorship as a primary avenue for action.

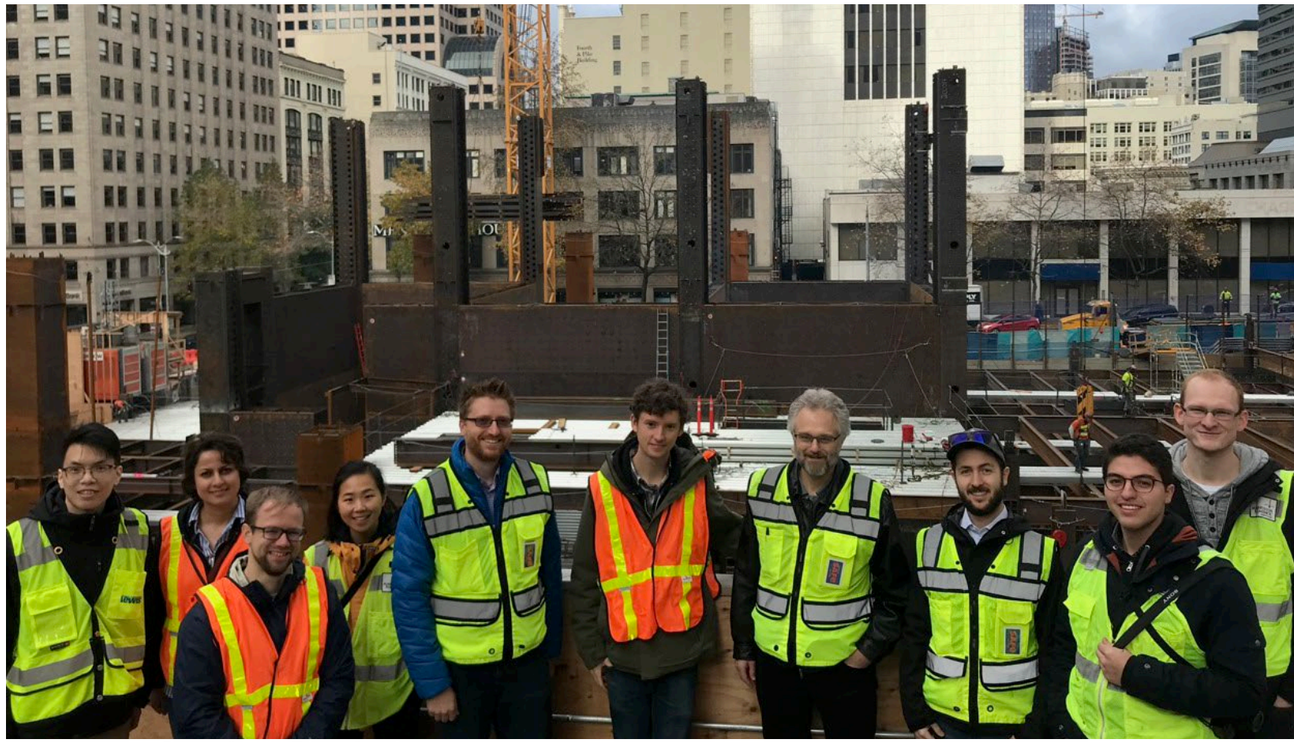
This first exercise has already yielded results. As we worked to capture bold ideas of how we might approach these challenges, someone wrote down "do real projects", and beside that, "open a student design consultancy". It was crazy enough to be exciting, and with a few tweaks, it has already been formed into an active proposal.

Steel Centre OutReach Engineering (SCORE) has already completed its first projects. From there, the sky is the limit as we continually evaluate our programs and encourage students to bring new ideas. Read more about SCORE on page 30.

Spending time thinking about the way we interact and work has proven to be a very useful activity, and will help the Steel Centre continue to "challenge traditional boundaries" as we work to invigorate engineering education.



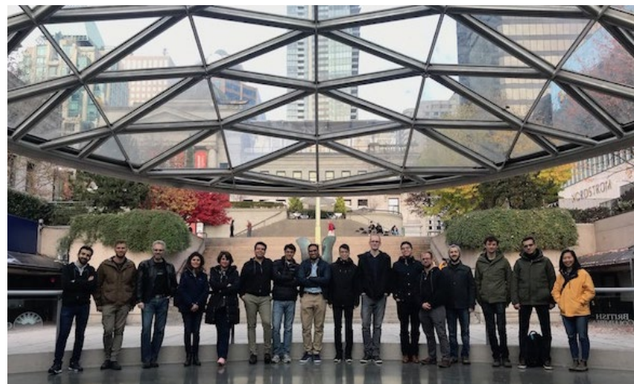
West Coast SuperTour



Rainier Square Tower, Seattle

In November, the Steel Centre took wing to the West Coast, visiting a number of notable steel construction projects and learning firsthand from the engineers and fabricators behind them. Students travelled to Vancouver and Seattle, partnering with firms in the area to get backstage access to the design and construction process for award-winning designs.

Students and professors from the Steel Centre learned from a week of back-to-back visits. While most were steel buildings, students also saw some other interesting applications of steel. Dynamic Attractions builds 4D robotic theatre boxes for theme parks like Universal Studios; another department is working on precision engineering the world's largest telescope enclosures. The Robson Square Domes, below, are part structure and part art; the fabricator and engineer invested considerable time in creating clean, visually attractive connections. These varied examples of engineering in action sparked conversations and opened up new lines of thinking.



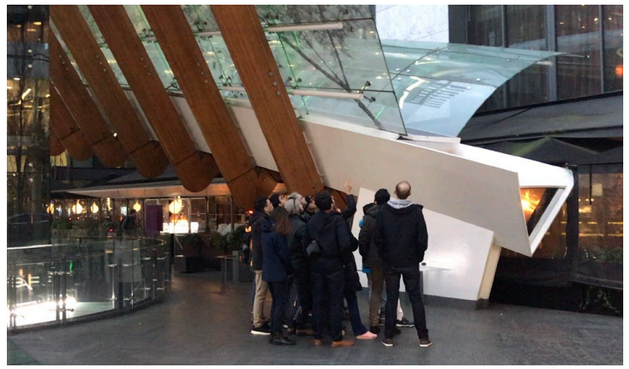
The highlight of the trip was the Rainier Square Tower, a 60-storey Seattle skyscraper that will be the first building to use the innovative SpeedCore hybrid steel–concrete shear wall system.

First, in Vancouver, the group saw the fabrication in process at Supreme Group's facility. As a founding member

Supreme Group, Vancouver

of the Steel Centre, Supreme Group is very closely involved in the Steel Centre's research and education programs, and it is exciting to see their involvement in such a high-profile project.

The following day in Seattle, Magnusson Klemencic Associates (MKA), the engineering firm behind the design,



Telus Square Garden, Vancouver

took the Steel Centre backstage to see the construction in progress and hear more about the design challenges in developing the SpeedCore system, providing a great learning opportunity to see this innovative system from start to finish.

The week's events were overwhelmingly positive, and students have brought home a wealth of new ideas and inspiration. Thank you to the many hosts, including Steel Centre members Supreme Group, S-Frame Software, and DIALOG, who gave up work time and weekends to invest into this upcoming generation of structural engineers.

Rainier Square Tower

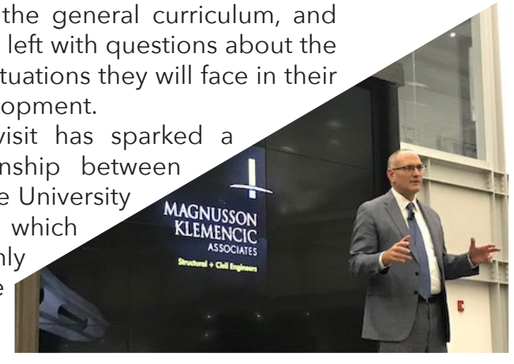
Ron Klemencic, Executive-in-Residence

The SuperTour was capped with a special visit to the University of Alberta by Ron Klemencic, CEO of Magnusson Klemencic Associates (MKA), a globally-recognized structural design firm. Ron spent two days exclusively with the Steel Centre to share his expertise, including a keynote presentation for the public at the facility of Steel Centre founding member Supreme Group in Acheson.

Ron's passion for engineering was evident in his many conversations with students. He freely shared his experiences, pulling out actual work samples to help explain a point. Ron showed the importance of combining technical engineering skills and higher-order thinking to work collaboratively and challenge ideas in order to create some of the world's most ambitious projects.

Senior-level guests from Stantec, RJC, and Steel Centre member DIALOG joined Ron at a special lunchtime panel session. The group of engineering all-stars spoke to the Steel Centre and structural engineering students about the challenges and realities of managing a consultancy. This sort of information is not part of the general curriculum, and students are left with questions about the real-world situations they will face in their career development.

The visit has sparked a new relationship between MKA and the University of Alberta, which will certainly be of value to students.



S.C.O.R.E.
Steel Centre OutReach Engineering

A new student-led engineering consultancy will take on actual projects from our industry partners to teach real-world skills and build genuine mentorship.

Steel Centre OutReach Engineering (SCORE) is a student-led engineering consultancy devoted to innovative solutions to real-world problems in the field of structural engineering. The primary goal is to provide opportunities for students to develop technical and interpersonal skills while assisting the Steel Centre's industry partners ("clients") to obtain solutions for challenging problems without being constrained by conventional practices. By participating in SCORE projects, students will gain from the years of accumulated insight at Steel Centre member organizations. Both industry professionals and students will enjoy the benefits of forming new relationships built on authentic mentorship experiences.

SCORE works exclusively with the Steel Centre's member organizations, adding to the already significant portfolio of membership benefits. SCORE offers M.Sc. and Ph.D. students who have the technical fundamentals and fresh perspectives to solve difficult problems using innovative and creative solutions. After an initial startup period, students will evaluate the potential for undergraduates to join as well.

Once a proposal request is submitted to SCORE, the students of the Executive Council will be responsible for communicating with the client and corodinating the preparation of a proposal and budget. The Executive Council will present the project to SCORE members to determine capacity, interest, and availability. If the project is approved to move forward, the Executive Council will submit a proposal in consultation with the project members.

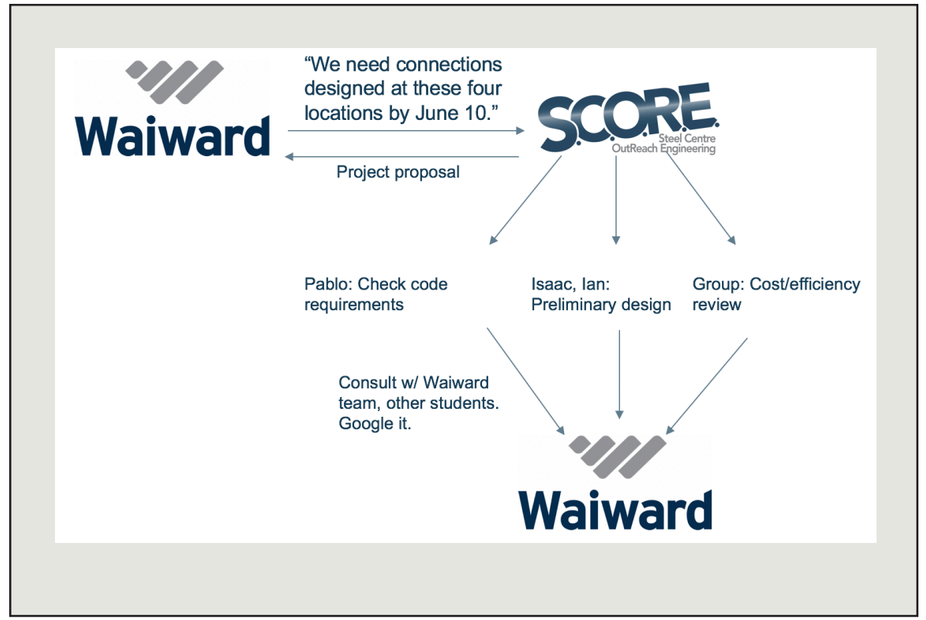
Once the proposal is accepted, a contract will be signed by the client, a member of the Executive Council, and the Project Lead, a rotating position that will give all students project management experience. Each member of the SCORE team will commit their time for the duration of the project, just as they do for any other extracurricular activity.

SCORE plans to implement a "mini" integrated project delivery model (IPD), whereby co-location and access to the people, technology and resources of clients encourage collaboration and professional development. For organizations based in Edmonton, the team will travel to the client's office one day per week for the duration of the project. For companies that are not based in Edmonton or cannot offer office space to the project team, SCORE will hold online meetings. Once the project is completed, there will be a close-out meeting in which SCORE will present their work and deliverables to the client and to other students. At this time, the client will have an opportunity to provide constructive feedback to further enhance the learning potential of the experience.

SCORE will not actually bill clients, but rather request donations to worthy charity selected in discussion with the client. The donation shall be determined as a percentage of the fee of a junior engineer. Students will prepare a real-cost quotation within the proposal to help gain experience in estimating and working to meet targets--as well as mitigating expenses when projects overrun.

The Steel Centre is immensely proud of our students for their efforts and energy in launching this new program. A special thank you to our member organizations, without whom SCORE and other innovations like it would be impossible to imagine or implement.

how it works



community

The Steel Centre goes waaay off-campus to put their skills to work for the good of others.

Three graduate students took their education beyond the confines of the classroom in summer 2018, travelling to Bolivia with the Bridges to Prosperity foundation (B2P) to assist in the construction of three pedestrian footbridges in isolated communities around Bolivia. The Steel Centre team got involved in the preliminary design work while still in Edmonton, assisting the U of A B2P chapter as mentors under their Bridge Corps team. After approval by B2P's central oversight team, it was time for construction.

Three Steel Centre M.Sc. students–Pablo Cano, Dimple Ji, and Michael Manarin–travelled to remote parts of the country during the month of June, facing down national strikes and last-minute changes in plans. Meanwhile, colleagues in Edmonton waited for news that never came: the bridge sites had no cell service and no electricity. The team learned from a number of logistical and technical challenges of a remote jobsite with limited means of communication. They had to mix concrete by hand after a crucial part of the mixing machine was discovered to be missing, with the nearest town over four hours away.

Pablo Cano (right), was filled with energy upon his return. He and his team of engineers from around Canada worked alongside local community members to complete the bridge construction with no technology and a lot of manual labour.

Everyone knew they would return with a deeper understanding of bridge construction. However, there were many more lessons gained: appreciation for the level of comfort enjoyed in Canada, both at home and at work; amazement at the impressive speed and efficiency of community members, even with only basic hand tools; and above all, the real meaning of flexibility. The team was initially scheduled to work together on a single bridge. Then, a strike shut down the only road to the construction site and Dimple was hastily relocated to assist in a similar bridge underway in another part of the country. When Pablo arrived, he was able to reach the U of A bridge but still had to work through a lack of equipment, unconventional transport methods for tools and materials, and a grueling hike at high altitude at the end of a long work day. The effort paid off, with the bridge completed ahead of schedule. The last Steel Centre member, Michael, was even able to move to a third bridge site after the U of A project was finished.

Understanding the need for flexibilty amidst constantly shifting circumstances is now a lived experience for this group of students, and they will bring that insight into their work at home. The Steel Centre, together with the Supreme Steel Professorship, are proud to be Platinum sponsors for the University's first-ever independent bridge project with Bridges to Prosperity.

in the news

Advantage Steel
CISC Steel Centre creating impact in Education and Research at the University of Alberta

Canadian Fabricating & Welding
CISC Centre for Steel Structures Education & Research aims to bridge divide between industry, academia

Canadian Institute of Steel Construction (CISC)
CISC Centre for Steel Structures Education & Research Launches Today!

Construction Canada
New learning centre for Canadian steel construction

Construction Business
Forging Industry Partnerships

Daily Commercial News
University of Alberta's Steel Centre looks to forge the future

Edmonton Journal
Steel centre forged for University of Alberta engineers

Journal of Commerce
University of Alberta's Steel Centre looks to forge the future


Steel

Forging Industry Partnerships

BY MATT JEPPESEN

Steel

A partnership years in the making is examining how universities can leverage the interplay between academic research and engineering education. In parallel with a traditional physical testing programme, the Steel Centre is working with its members to imagine the future of construction. How will artificial intelligence and computational design change the role of engineers and designers? Where are new opportunities for collaboration across disciplines to ensure the construction industry catches the technology wave? What must change about the ways we educate young engineers to ensure their success in a rapidly changing work environment? The Steel Centre and its member organizations are working to establish the big ideas that anticipate the next 10 and 20 years of steel engineering.

The Steel Centre continually works to "shed traditional boundaries" (a key institutional buzzword) in both education and research spaces, through industry–academic partnerships, and new opportunities for education and training. Especially in this latter realm, opportunities abound for updating and reshaping how engineers gain the skills they need to succeed as professionals. As such, education is at the core of the Steel Centre mission. Reaching beyond the traditional research group, the Steel Centre seeks to become the hub for innovative engineering education. Building on the University of Alberta's well-established reputation for the high quality of its engineering graduates, academic excellence is complemented by new, more immersive and hands-on experiences in the same settings that graduates will one day practice as professionals.

How do we do it? Steel Centre member organizations take a highly integrated role in the training of our young engineers. They provide feedback on ongoing research, share insights into technology trends in industry, and teach students the skills they'll need to succeed from day one. Steel Centre students come from all levels of their academic career, from new undergrads to Ph.D candidates. Everyone benefits from our close relationships with industry leaders in experience and understanding. In contrast with industry partners, we launched a different kind of program, specifically targeting younger students at earlier stages in their training. The Steel Squad began in fall 2017 as a competitive-entry group to provide unique opportunities for undergraduate students interested in structural steel. Five students from any program year are selected annually, and remain in the Squad for the duration of their academic careers. The Squad welcomed its first five members in 2017 and will grow to the full complement of approximately 15 members by fall 2019. The Steel Squad offers students real-world experiences such as shop tours, jobsite tours, job shadowing and mentorships, and hands-on demos such as an exciting welding day hosted in November by Collins Steel Ltd. As students cultivate up-to-date understandings of the changing professional landscape.

However, just interacting with industry leaders is extremely high from both industry and students to explore how to further expand the much and impact of this new program.

One such attempt is just taking off: Steel Centre OutReach Engineering (SCORE), a student-led engineering consultancy that takes on real projects with Steel Centre member organizations. The primary goal is to provide opportunities for students to develop technical and interpersonal skills, while assisting the Steel Centre's industry partners (clients) to obtain solutions for challenging problems without being constrained by conventional practices. By participating in SCORE projects, students gain from the years of accumulated insight at Steel Centre member organizations. Both industry professionals and students reap the benefits of forming new relationships built on authentic mentorship experiences. Students have already significant portfolio of membership benefits. SCORE offers M.Sc. and Ph.D. students, who have the technical fundamentals and fresh perspectives, the opportunity to solve difficult problems using innovative and creative solutions. After an initial startup period, students will evaluate the potential for undergraduates to join as well.

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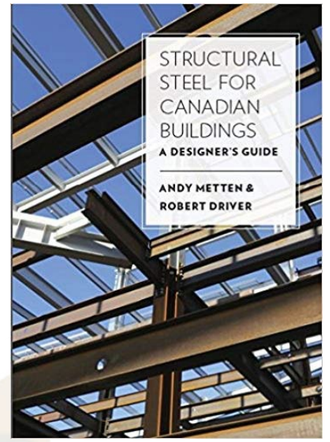
practice-oriented textbook

Steel Centre Director Dr. Robert Driver has co-authored a new design textbook for professionals and students alike. ***Structural Steel for Canadian Buildings*** (Metten and Driver 2016) presents a practical, design-office approach to designing structural steel buildings. It covers topics not traditionally treated in steel design books, including the conceptual design of roof and floor decks, open web steel joists, and hollow structural section steel trusses, the review of shop drawings, and an introduction to seismic design of steel structures. The book considers steel design within the context of the 2015 National Building Code of Canada and CSA S16-14, examining the entire structural system and the ways in which individual elements fit within the structural system as a whole. Current design practice is demonstrated using worked examples.



The text has been written for practising engineers who wish to keep current. Fourth-year and graduate-level engineering students will also find it relevant to their studies. The book integrates all aspects of Canadian steel design and is essential reading for Canadian engineers who design with steel. The book presents the reader with a practical approach to steel design that will be beneficial to engineering students who hope to work in a consulting design office and to those who already work in structural steel design.

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Steel Centre publications

Steel Centre students underlined.

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Ji, X.L., Driver, R.G., and Imanpour, A. (2018). "Lateral-Torsional Buckling Response of Welded Wide Flange Girders". Annual Stability Conference, *Structural Stability Research Council*, Baltimore, MD, United States, April 10-13.

Imanpour, A., Tremblay, R., Leclerc, M., and Siguier, R. (2018). "Development of Hybrid Simulation Computational Model for Steel Braced Frames". *9th International Conference on Behavior of Steel Structures in Seismic Areas*, Christchurch, New Zealand, February 14 - 17.

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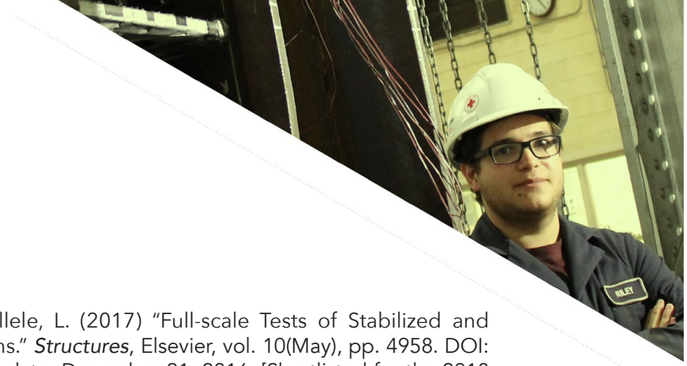

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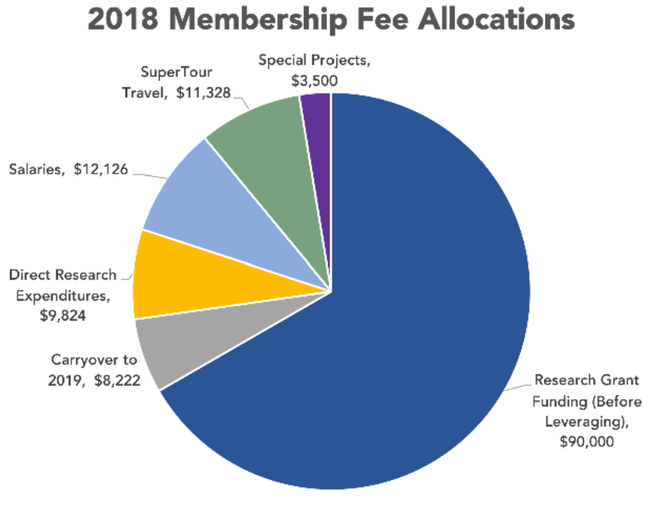
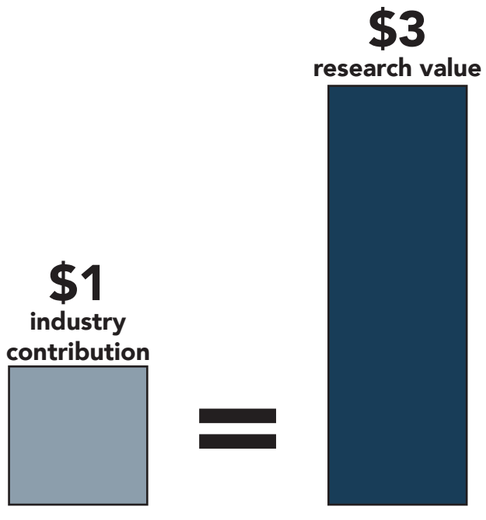
Financial overview

2018 at the Steel Centre saw the beginning of several new endeavours, in both education and research. Because the educational programs have been created with minimal budget requirements, research expenditures are by far the most significant area of financial investment. Grant funding, in which Steel Centre funds are applied toward research grants to receive matching funds, are the major means of accomplishing the Steel Centre's work. In this way, the $90,000 invested becomes $270,000 in research funds.





Because of the Steel Centre's ability to use matching funds for the majority of expenditures, combined with the University of Alberta's significant secondary support for researchers, students, and infrastructure, every dollar of industry membership fees has three dollars of effective purchasing power.

Steel Centre members

The Steel Centre is strengthened by enthusiastic support from our industry partners, who represent every step in the construction process: design, analysis, fabrication, and construction. Founding members Collins Steel Ltd., Waiward Steel LP, Supreme Group, Price Steel Ltd., and TSE Steel Ltd. sowed into a vision for an industry–academic hub to spark new ideas for the steel construction industry and engineering education. In just two years, five more organizations have joined this mission: WF Steel & Crane, DIALOG, S-Frame Software Inc., and the Edmonton Construction Association. Throughout the process, the Canadian Institute of Steel Construction (CISC), the nation's premier industry association, has supported and promoted the Steel Centre's efforts.

Our growth continues into 2019 as more organizations join our mission to imagine and transform the future of structural steel education and construction.

the STEEL centre

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